On Knowing the Auxiliary of a Verb That Cannot Be Named: Evidence for the Independence of Grammatical and Phonological Aspects of Lexical Knowledge

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Abstract

We report the case of an Italian anomic subject who was invariably able to provide the auxiliary of verbs he failed to produce in oral naming tasks. This pattern of performance contrasts with that of another Italian-speaking patient documented by Miceli and Caramazza (1988) who showed a selective impairment in accessing syntactic features of words, but not their phonological forms. This double dissociation suggests that syntactic and phonological information in the lexicon are accessed independently and represented in distinct neural structures.

INTRODUCTION

There is ample evidence that brain damage can selectively affect distinct aspects of lexical knowledge. Thus, brain-damaged subjects have been described who are selectively impaired in processing the semantic content of words (Hillis, Rapp, Romani, & Caramazza, 1990; Gagnotti, 1976; Patterson & Morton, 1985; Roeltgen, Rothi, & Heilman, 1986; Warrington, 1975; see Garrett, 1992 for review), or in accessing their phonological (Caramazza & Hillis, 1990; Kay & Ellis, 1987) or orthographic forms (Beauvois & Dérouesné, 1981; Goodman & Caramazza, 1986). These selective lexical deficits have important implications for theories of the structure of lexical knowledge and its organization in the brain (see Caplan, 1994; Caramazza, 1988; Garrett, 1992). In this paper, we report evidence that suggests that the retrieval of a word’s syntactic properties can be spared in the face of severe difficulties in retrieving the word’s phonological form. The implications of this pattern of performance are discussed in the context of current models of lexical access in speech production.

Most current theories of speech production assume that lexical selection involves at least two distinct stages of processing (Bock & Levelt, 1994; Butterworth, 1989; Caramazza & Hillis, 1990; Dell, 1986; Garrett, 1975, 1992; Howard & Franklin, 1989; Kempen & Huijbers, 1983; Levelt, 1989). In the first stage, a representation of the semantic and syntactic properties of the word, often referred to as lemma, is accessed; in the second stage, a representation of the phonological properties of the word, the lexeme, is accessed. The distinction between lemma- and lexeme-level representations, originally proposed to account for the distribution of errors in spontaneous speech (Fromkin, 1971; Garrett, 1975, 1976; see also Dell & Reich, 1981; Fay & Cutler, 1977; Harley, 1984; Stemberger, 1985), is motivated by various sorts of experimental results, including the response time data in naming and lexical decision tasks (Jescheniak & Levelt, 1994; Kempen & Huijbers, 1983; Levelt, Schriefers, Vorberg, Meyer, Pechmann, & Hivinga, 1991; Schriefers, Meyer, & Levelt, 1990), the analyses of hesitations in speech production (Butterworth & Beatty, 1978), and, as noted above, the naming performance of brain-damaged subjects, which shows that lexical-semantic (Gainotti, 1976; Warrington, 1975) and phonological word form representations (Caramazza & Hillis, 1990; Kay & Ellis, 1987) can be damaged independently one from the other.

Perhaps one of the more persuasive observations in support of the lemma/lexeme distinction is the tip-of-the-tongue (TOT) phenomenon—the failure to retrieve the phonological form of a word that subjects feel they know and is on the verge of coming (see Brown & McNeill, 1966). The feeling of knowing the target word despite the momentary inability to retrieve it in TOT states has been shown to be remarkably accurate (see Burke, MacKay, Worthley, & Wade, 1991; Jones & Langford, 1987; Kohn, Wingfield, Menz, Goodglass, Berko-Gleason, & Hyde, 1987; Kioriat & Lieblich, 1974; Lovelace,
1987; Perfect & Hanley, 1992; Rubin, 1975; for reviews, see A. S. Brown, 1991; Smith, 1994). In other words, it would seem that the TOT phenomenon reflects the situation in which the target lemma has been successfully accessed, but its corresponding lexeme is momentarily inaccessible. Thus, there would appear to be a substantial body of evidence that converges in support of the two-stage hypothesis of lexical access.

One of the principal motivations for the lemma/lexeme distinction was to capture the fact that word but not sound exchange errors in slips of the tongue are constrained by syntactic factors. Thus, for example, it has been observed that nouns exchange with nouns and not verbs or adjectives (e.g., Seymour sliced the knife with a salami; a hole full of flowers, from Fromkin, 1973) and that verbs exchange with verbs and not nouns or adjectives (e.g., I'll see it when I believe it, from Garrett, 1980); by contrast, sound exchange errors tend to occur within a phrase, between words of different grammatical classes. These facts have been interpreted as implying that the syntactic properties of a word are specified at the lemma and not the lexeme level.

Converging evidence for the hypothesis that syntactic features of words are represented independently of their phonological content has also been obtained in experimental tasks (Jeschelnik & Lebelt, 1994; Miozzo & Caramazza, 1996; Vigliocco, Antonini, & Garrett, in press). For example, Miozzo and Caramazza observed that Italian speakers in TOT states can often recall the gender—a word-specific syntactic feature of nouns—even when they fail to provide such phonological information as the initial or the final phoneme of the target word. The availability of gender in TOT states suggests that syntactic features can be accessed independently of the retrieval of a word's phonological form, a conclusion that is consistent with the hypothesized role of lemma representations in lexical access.

Further evidence in support of the hypothesized distinction between the syntactic and phonological contents of words comes from investigations of language impairments. The evidence concerns the performance of anomic subjects who successfully reported the syntactic features of words they failed to produce. Henaff Gonon, Bruckert, and Michel (1989) reported a French-speaking patient who, although unable to retrieve the phonological form of the name of an object, successfully indicated its gender. A more systematic investigation of the dissociation between grammatical and phonological information was presented by Badecker, Miozzo, and Zanuttini (1995). Their Italian-speaking patient, Dante, was able to report the gender of the nouns for which he failed to indicate, in a forced-choice task, their initial letter, their final letter, or their length. The ability shown by anomic patients to recall the gender but not the phonological form of a word is consistent with the lemma-lexeme distinction proposed in two-stage access models of the lexicon. The dissociation manifested by these patients also has important implications for our understanding of the organization of lexical knowledge in the brain: it suggests that distinct brain structures are implicated in the representation of lemma- and lexeme-level information.

Henaff Gonon et al. (1989) and Badecker et al. (1995) restricted their investigation to a syntactic feature of nouns, grammatical gender. A crucial question concerns the generality of the phenomenon: Are the syntactic features of verbs also represented independently of their phonological forms? The present study explores whether a lexical-syntactic property of Italian verbs—the aspectual auxiliary—is available to a brain-damaged subject (Dante) when he fails to access a word's phonological representation.

**CASE REPORT**

Dante is a 27-year-old Italian-speaking man, with eight years of education, who was originally reported by Sartori, Job, and Coltheart (1992). Until the onset of the illness, he was employed as a carpenter. In 1990 he was hospitalized for over a month in a comatose state. The EEG showed major irritative abnormalities in the right fronto-temporal areas. He was diagnosed as having an encephalitis of unknown origin. A CT scan showed a nonhomogeneous superficial hypodensity in the fronto-temporo-parietal regions. One month postonset Dante showed a severe memory deficit and naming difficulties. On the Weschler Memory Scale, he obtained an MQ score of 50. His speech was fluent, although he frequently encountered word finding difficulties. Asked to orally name a subset of pictures from the Snodgrass and Vanderwart's (1980) list, he successfully named 59/150 (39%) of the stimuli. Nearly all of his errors were circumscriptions (e.g., airplane → "it flies") or omissions. Dante's naming difficulties were not restricted to a particular modality of input or output. Omissions and circumscriptions appeared also in naming to verbal definition and in written naming. Writing to dictation seemed preserved.\(^1\) Dante's performance was good (Table 1) in two tasks designed to evaluate the intactness of visual processes (Sartori et al., 1992): In the object decision task, pictures of real objects had to be discriminated from pictures of nonexisting ones; in the part-whole matching task, a part appropriate for completing an object had to be chosen from among different instances of that part (e.g., four different types of heads). In both tasks, Dante's performance did not differ from that of controls.

A number of tasks were carried out to determine the functional level of Dante's naming impairment (Badecker et al., 1995). The results of these tasks allow us to draw the following conclusions:

a) Dante's semantic processing abilities seemed to be "intact." In a name/picture matching task, he consis-
Table 1. Dante’s performance across visual, semantic, and phonological tasks (from Sartori et al., 1992; Badecker et al., 1995). Number of correct responses over total responses and percentages in parentheses.

<table>
<thead>
<tr>
<th>Task</th>
<th>Chance</th>
<th>Number correct (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object decision</td>
<td>.50</td>
<td>46/48 (96)</td>
</tr>
<tr>
<td>Part-whole matching:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td>.25</td>
<td>13/16 (81)</td>
</tr>
<tr>
<td>Artifacts</td>
<td>.50</td>
<td>47/50 (94)</td>
</tr>
<tr>
<td>Name-picture matching</td>
<td>.25</td>
<td>80/80 (100)</td>
</tr>
<tr>
<td>Recall of phonological features:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First letter</td>
<td>.50</td>
<td>47/88 (53)</td>
</tr>
<tr>
<td>Last letter</td>
<td>.50</td>
<td>41/88 (47)</td>
</tr>
<tr>
<td>Word length</td>
<td>.50</td>
<td>44/88 (50)</td>
</tr>
<tr>
<td>Rhyming word</td>
<td>.50</td>
<td>42/88 (48)</td>
</tr>
<tr>
<td>Masculine noun’s article</td>
<td>.50</td>
<td>26/60 (43)</td>
</tr>
</tbody>
</table>

Dante’s performance was unchanged with respect to the descriptions provided in previous reports. However, his reading performance deteriorated in this period. Asked to read a total of 494 words of different length, Dante correctly pronounced 63% of the stimuli. Omissions, additions, and substitutions of a single letter (e.g., *domino* [dominion] → *domino*, *brano* [excerpt] → *brando*, *babbo* [father] → *barbo*), and, occasionally, of more than one letter (e.g., *radio* [radio] → *rapido*), accounted for 78% of the errors. The remaining errors consisted of stress errors—the segmental structure of the word was maintained, but the stress was misplaced (e.g., *fragile* [fragile] → *fragile*, *orfano* [orphan] → *orf’ano*). Frequency affected his reading performance: He correctly named more high-frequency words (21/30; $z^2 (1) = 7.02, p < 0.05$). His performance in visual lexical decision tasks was also severely impaired (65% correct).

VERB NAMING TASK

In order to determine whether the syntactic features of a verb can be accessed independently of other properties of the word, it has been observed that these features are not derivable from the verb’s semantic properties, its phonology, or the context in which the word is used. The aspectual auxiliary of Italian verbs is a feature that satisfies these conditions. Two auxiliaries, *avere* and *essere* (have and be; henceforth A and E, respectively), are used in Italian to create compound active forms such as the present perfect. Thus, for instance, the auxiliary A appears in the sentence *Gianni ha mangiato* (Gianni *has* eaten), while the auxiliary E appears in the sentence *Gianni è arrivato* (Gianni *has* arrived). For transitive verbs, auxiliary selection is straightforward: They always take the auxiliary A. Intransitive verbs can take either form, as exemplified in the following sentences:

1. *Gianni ha viaggiato* in Italia (Gianni traveled in Italy)
2. *Gianni è andato* in Italia (Gianni went to Italy).

It is important to stress that auxiliary assignment is not dictated by semantic aspects of the intransitive verb (for an extended discussion of this point, see Burzio, 1986). Furthermore, no correlation is evident between a verb’s auxiliary and its phonological form. Because of these characteristics, aspectual auxiliary appears to be a good candidate for investigating whether, as proposed by two-stage models of lexical access, a verb’s syntactic features are distinctly represented from its phonological form. If there is such a distinction, Dante should be able to retrieve the correct auxiliary form of a verb even when he fails to access its phonological representation.

Dante was asked to complete an aurally presented sentence by producing a transitive or an intransitive verb along with its auxiliary. Examples of the experimental material are presented in Figure 1. To ensure that the subject would search for the intended target verb, the sentences were accompanied, whenever possible, by a picture. In the preparation of the material, care was used to avoid the inclusion of syntactic cues such as the clitic *ne* and the reflexive *si*, which correlate with specific auxiliary types (Burzio, 1986). Target verbs were always in the present perfect form, a tense that in Italian requires the auxiliary. Targets were either transitive (N = 59) or intransitive verbs (N = 126). Given the correspondence between verbs’ transitivity and auxiliary form, responses to transitive verbs were used to estimate baseline performance. The auxiliary of intransitive target verbs was *avere* in 48 cases and *essere* in 78 cases.
At yesterday’s concert, the chorus [sang] very well.

Yesterday, at the election Maria and Marco [voted] for candidate number 1.

Yesterday morning the sun [rose] at 5:30.

Written sentences were presented to the subject one at a time. The sentences contained a gap for the missing auxiliary + verb, as in Figure 1. The experimenter read aloud each sentence to the subject at a normal conversational pace. Repetitions were provided on request. On each trial where Dante was unable to produce the verb, he was asked to identify first the auxiliary form and then the initial phoneme. For each feature, two alternatives were visually presented and read aloud by the experimenter. Dante’s task was to point to the auxiliary (either A or E) appropriate for the verb. A phoneme was randomly assigned to be the false initial phoneme of a particular target verb. After the subject had responded to the two questions a phonological cue (the initial letter) was provided to induce the generation of the target word.

Dante successfully named 115/185 (62%) of the verbs. This number includes 5 responses where the subject produced a different verb than that expected by the experimenter but sufficiently close to be scored as correct. For example, he produced è scoppiato (blew up) instead of the expected è esploso (exploded). Given the high concordance (96%) between the words produced by the subject and those expected by the experimenter, we can be confident that in the vast majority of cases, Dante was searching for the expected target forms when he was in an anomie state. When Dante failed to provide a response up to the point of the presentation of the phonemic cue, his response was scored as an “omission.” A total of 70 omissions were recorded—17 with transitive and 53 with intransitive verbs.

Dante’s performance in guessing the auxiliary and the initial phoneme of the verbs he was unable to produce is summarized in Table 2. A striking dissociation emerged between his ability to guess the auxiliary form and his ability to guess the initial phoneme. He almost invariably chose the correct auxiliary form of the verb but was at chance level in his ability to choose the initial phoneme of the word. Finally, the presentation of the phonological cue (the word’s initial phoneme) successfully induced the production of the verb in only 11% of the cases. This result is consistent with earlier observations with Dante (Badecker et al., 1995) where it was found that he needed considerably more information than the first phoneme in order to reliably produce the target word.

### Table 2. Dante’s recall of auxiliaries and initial phonemes for omitted verbs. Number of correct responses over total number of responses and percentages in parentheses.

<table>
<thead>
<tr>
<th>Verb form</th>
<th>Auxiliary form</th>
<th>Number of correct auxiliary</th>
<th>Number of correct initial phoneme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transitive</td>
<td>A</td>
<td>17/17 (100)</td>
<td>9/17 (53)</td>
</tr>
<tr>
<td>Intransitive</td>
<td>A</td>
<td>22/22 (100)</td>
<td>12/22 (55)</td>
</tr>
<tr>
<td>E</td>
<td>30/31 (97)</td>
<td>14/31 (45)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69/70 (99)</td>
<td>35/70 (50)</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

A property of the auxiliary system of Italian verbs is that the auxiliary of a verb cannot be derived from specific semantic characteristics or phonological properties of the verb. The auxiliary that is associated with a verb is an arbitrary syntactic fact about that word. Thus, access to information about the auxiliary of a verb depends on successful access to the word’s syntactic features. This fact about the structure of the aspectual auxiliary system of Italian allows us to investigate the relationship among syntactic, semantic, and phonological properties of words.

The results we have reported demonstrate that Dante could correctly identify the auxiliary form of verbs he failed to name. His contrasting performance in accessing syntactic and phonological aspects of verbs provides important constraints concerning the nature of the lexical processes implicated in the selection of the grammatical properties of words. The fact that the assignment of the appropriate auxiliary for a verb cannot be derived from specific semantic characteristics of the verb rules out the possibility that Dante’s successful recall of this grammatical feature is directly based on the availability...
of semantic information. Thus, we can interpret his successful performance in retrieving the auxiliary of verbs as an indication that he is able to normally access the syntactic features of words. More specifically, the dissociation between Dante’s ability to retrieve a verb’s auxiliary and his inability to retrieve the verb’s phonological features demonstrate that syntactic features of words can be accessed independently of their phonological specification. This conclusion is consistent with two-stage models of lexical access in which the first stage consists of the selection of a semantically and syntactically specified representation and the second stage consists of the selection of a specific phonological (or orthographic) lexical form.

In a previous investigation of Dante's naming deficit, Badecker et al. (1995) documented a dissociation in this subject’s ability to retrieve the grammatical and the phonological features of nouns. Thus, he could correctly identify the gender of nouns, a word-specific syntactic property of these words, despite his failure to access their phonological forms. A similar dissociation between gender and phonological forms was also observed in the anomic subject reported by Henaff Gonon et al. (1989). The emergence of comparable patterns of results with nouns and verbs suggests that the syntactic features of both grammatical categories are represented and accessed independently of their phonological properties.

The pattern of performance exhibited by Dante contrasts with that of another Italian-speaking patient, ES. (Miceli & Caramazza, 1988), who, in some respect, showed the opposite pattern of deficits: a selective impairment in accessing the grammatical properties of nouns and verbs, but not their phonological forms. In repeating aurally presented words, ES. produced as errors well formed, inflectionally related words (e.g., rossa (red, masc.) → rossa (red, fem.); vestito (to wear) → vestiti (you were wearing). More relevant to the present context is the fact that the same sort of word substitutions appeared in spontaneous speech with nouns. Thus, for instance, ES. produced “Poi a ascolto il (masc. sing.) televisione (fem. sing.)” (then I listen [to] the television); and “...perché il (masc. sing.) giornata (fem. pl.) sono/ lungo (masc. sing.)” (...because the days are) long. In these examples, the selection of the correct phonological forms televisione and giornata is not accompanied by the correct retrieval of the gender information needed to select the definite article (la and le, respectively), and the proper inflection of the adjective (lunghe, in this case). In other words, this case may represent a situation in which the lexeme of a word is correctly retrieved despite the failure to activate the correct syntactic features of the word.

The fact that syntactic and phonological information can be damaged selectively implies that syntactic and phonological information are distinctly represented, a conclusion that is consistent with current theories of the lexical system. However, this double dissociation further suggests that syntactic and phonological information can be independently retrieved. This latter conclusion is problematic for those models of lexical selection that assume that the retrieval of a word’s phonological form is mediated by access of its syntactic properties (see Bock & Levelet, 1994). On this view, the selection of a word’s phonological form requires the previous activation of its syntactic features. Thus, the selective disruption of syntactic information is expected to adversely affect the retrieval of phonological forms. However, ES.’s pattern of errors illustrates the possibility that phonological forms can be selected independently of the activation of (some) lexical-syntactic features.

There is now some experimental evidence that demonstrates that access of word’s phonological form does not require the prior retrieval of its syntactic features. In a series of experiments, Jescheniak and Levelet (1994) asked Dutch-speaking subjects to report the gender of a picture’s noun. This gender decision task was preceded by a naming task involving either the production of the name of the picture or the full noun phrase (Art.+Noun). A priming effect of naming on gender decision latencies was found in the condition where the article was produced, but not when the noun alone was generated. This pattern of results demonstrates that lexemes can be directly activated from the semantic representation without the mediation of the syntactic information, thus suggesting that syntactic and phonological features are independently accessed. These latter conclusions are consistent with the results of a study of the tip-of-the-tongue (TOT) phenomenon with Italian speakers (Miozzo & Caramazza, 1996). Subjects in TOT states were asked to indicate (between two alternatives) the gender and the initial letter of the target noun. It was demonstrated that the probability of recalling the initial phoneme is not affected by the availability of gender. This result implies that the retrieval of phonological information does not depend on the prior retrieval of the word’s syntactic features.

In summary, the contrasting patterns of selective impairments in retrieving syntactic and phonological information of nouns and verbs, together with recent experimental data, argue for the hypothesis that grammatical and phonological information are distinctly represented and independently accessed. Additional evidence suggesting that certain brain structures are specifically devoted to the processing of grammatical features is offered by studies showing that brain damage can selectively affect specific grammatical categories of words, such as nouns and verbs (Breedin & Martin, 1996; Caramazza & Hillis, 1991; Damasio & Tranel, 1993; De Renzi & di Pellegrino, 1995; Hillis & Caramazza, 1995; McCarthy & Warrington, 1988; Miceli, Silveri, Villa, & Caramazza, 1984; Zingeser & Berndt, 1988). The fact that these grammatical category deficits arise as a consequence of relatively large brain lesions precludes the possibility of proposing detailed hypotheses about the
anatomical correlates of syntactic and phonological lexical representations. Nevertheless, the available neuropsychological data lead us to conclude that a fractionation of lexical knowledge along the boundaries of syntactic and phonological information is directly represented in the brain.

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Notes

1. Italian orthography is highly transparent at the segmental level. Only a small number of Italian words (e.g., words that have the graphemic segments <cu> and <qu>, both of which correspond to the sound /ku/) require access to lexical-graphemic representations for correct spelling (this is not the case in reading, however; see: Miceli & Caramazza, 1993, for discussion). Dante made errors with words of the latter type (e.g., cuore [heart] → quore). However, because of his relatively low level of education, these errors could not be given a straightforward interpretation.

2. The production of stress errors (e.g., fra'gile → "frag'ile") is consistent with the hypothesis that Dante's access to lexical-phonological forms is impaired. In Italian, stress is a word-specific feature. A deficit in accessing phonological lexemes will result in stress errors in oral reading (for a detailed discussion of this point see Miceli & Caramazza, 1995).

3. We are indebted to William Badecker for having brought our attention to this syntactic feature of Italian verbs.

REFERENCES


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